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US 5351657 A US 4554787 A US 4462345 A

(58) Field of Search
UK CL (Edition Q) F1B B5R1D
INT CL^6 F01B 3/04 3/06 9/06 , F02B 75/26
Online: EPODOC, JAPIO, WPI

(54) Abstract Title

I.c. engine with guide channel(s) instead of a crankshaft

(57) The pistons 5 in a pair of rotatable or fixed opposed cylinders 1, 2 are connected by a piston rod 3 which passes through a rotatable cylindrical guide body 7. The rod 3 carries a radial pin 8 which engages a guide channel 9 formed in the internal wall of the guide body 7. Thus the piston rod 3 and guide body 7 are constrained to rotate relatively. A cylindrical coupling shaft 10 is located around the rod 3 and is keyed to rod 3 by a pair of axial slots 14 within which the pin 8 is free to travel axially. The shaft 10 has an annular end plate 15 carrying a bevel ring gear 16; a similar ring gear 17 is formed on the adjacent end of the body 7 so that gears 16, 17 contra-rotate and engage a single gear 19 on an output shaft 20. In a modification, fig.3, the pin 8 engages an external groove in each of a pair of contra-rotating guide bodies 21. In a further modification (fig.5), the cylinders are rotatable and are fixed to guide bodies (34, 35) with internal guide channels (14a, 14b). Supercharging from compressed air reservoirs is disclosed (fig.6). Suitable valve arrangements (figs.8,9) and a fuel injection system (fig.10) are also disclosed.

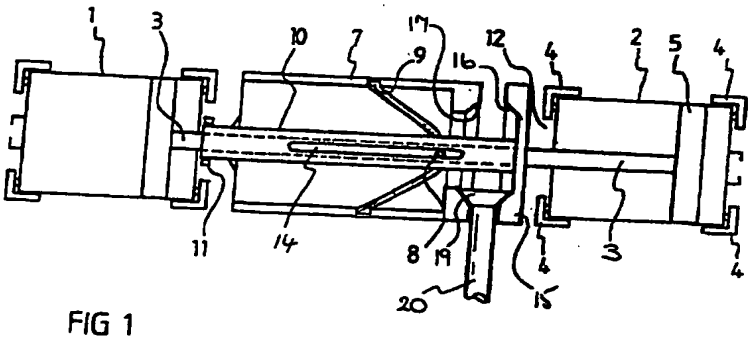

FIG 1

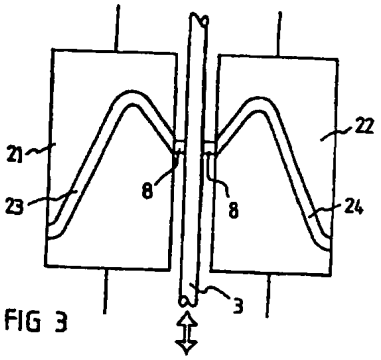

FIG 3

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

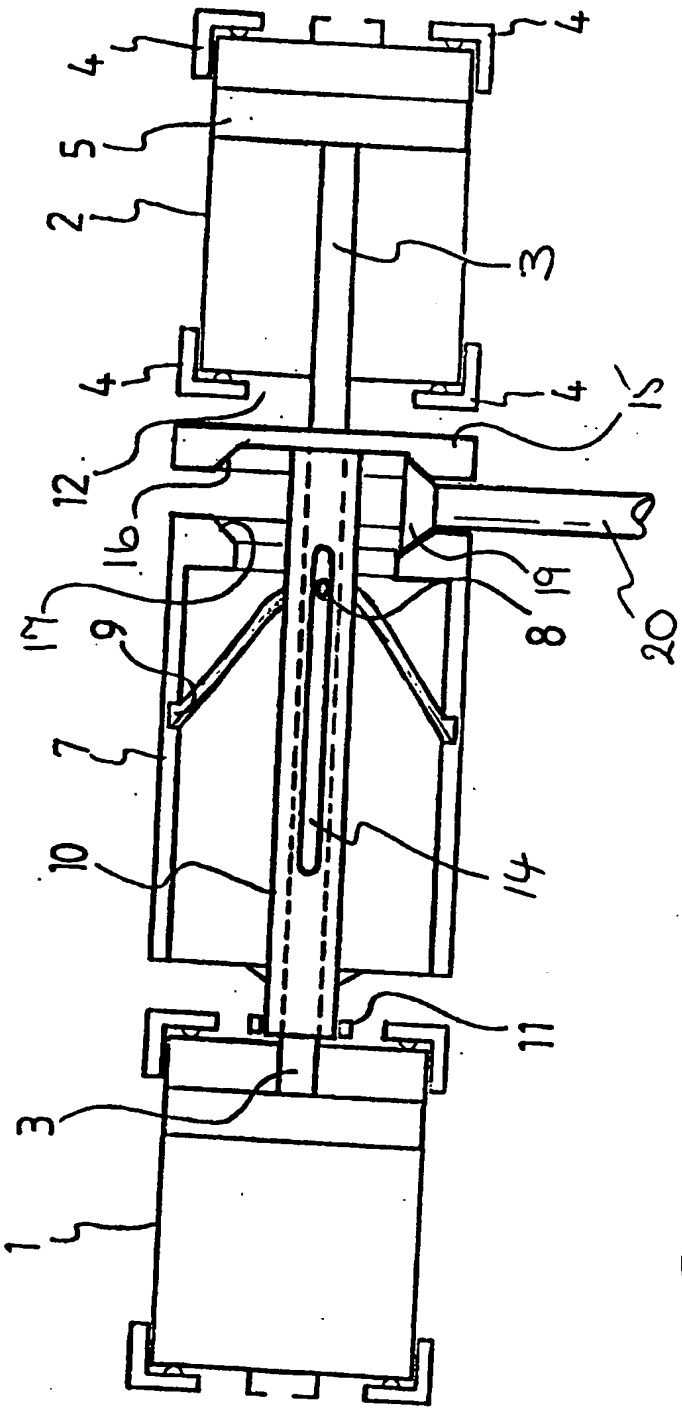

FIG 1

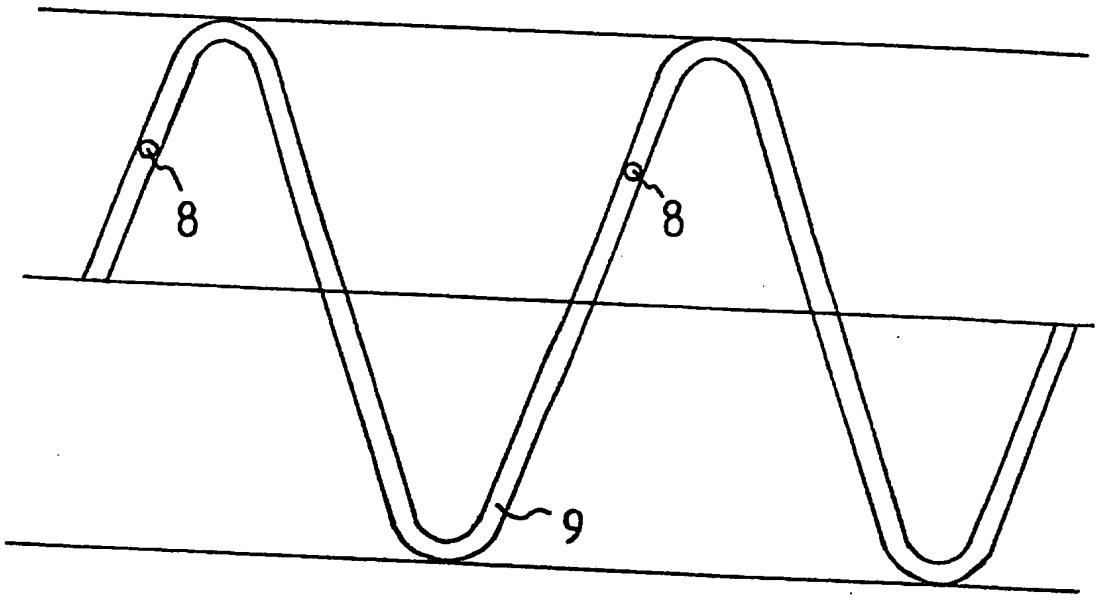

FIG 2

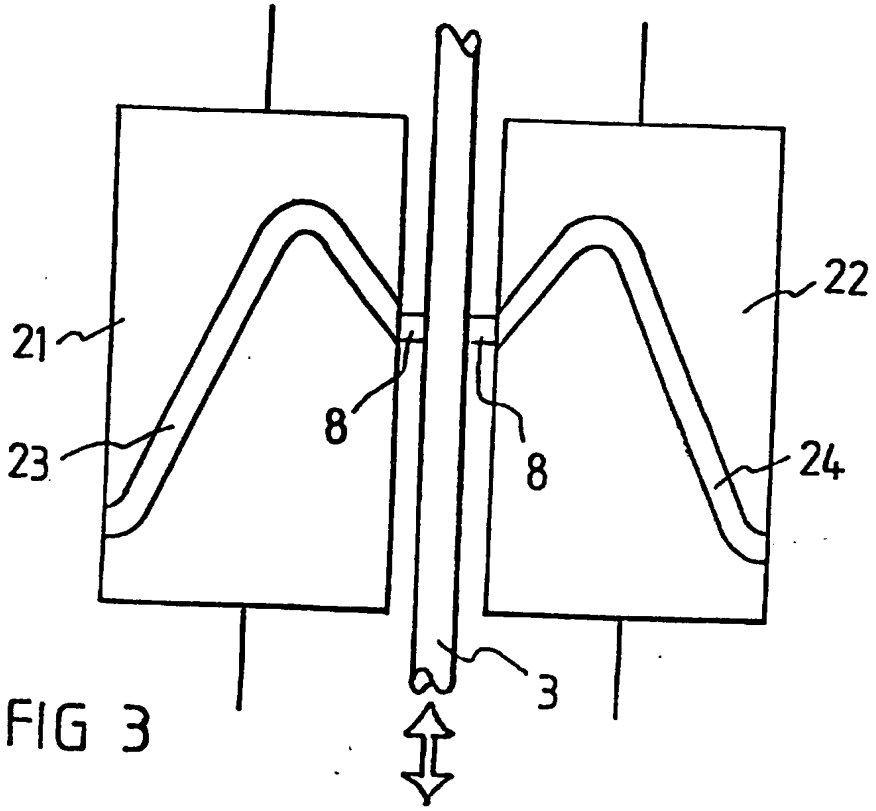

FIG 3

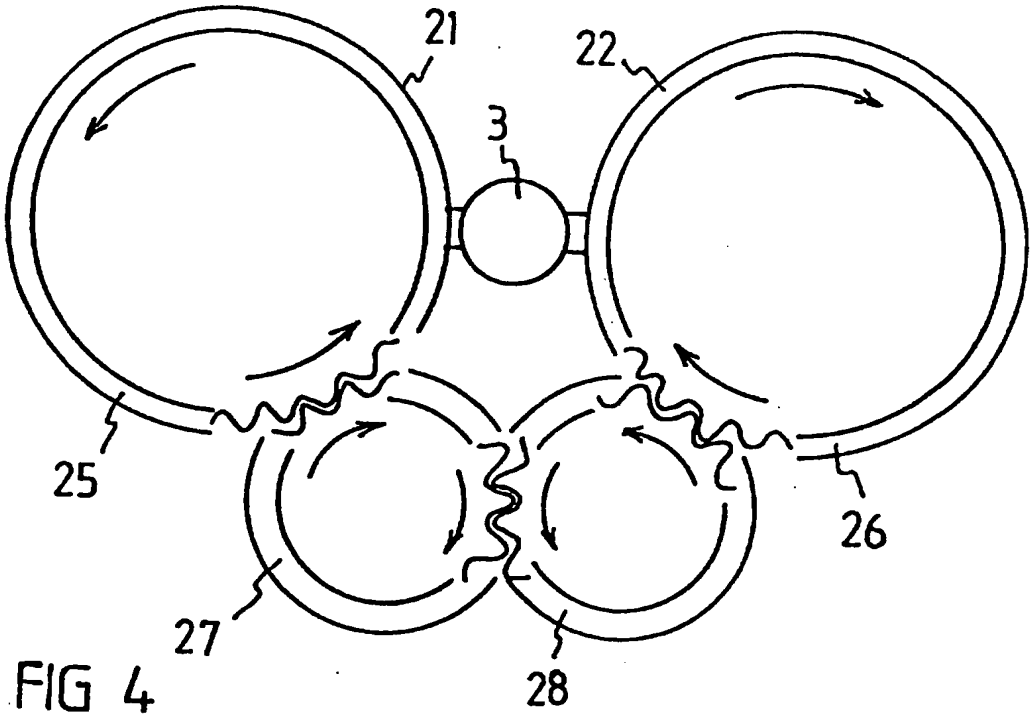

FIG 4

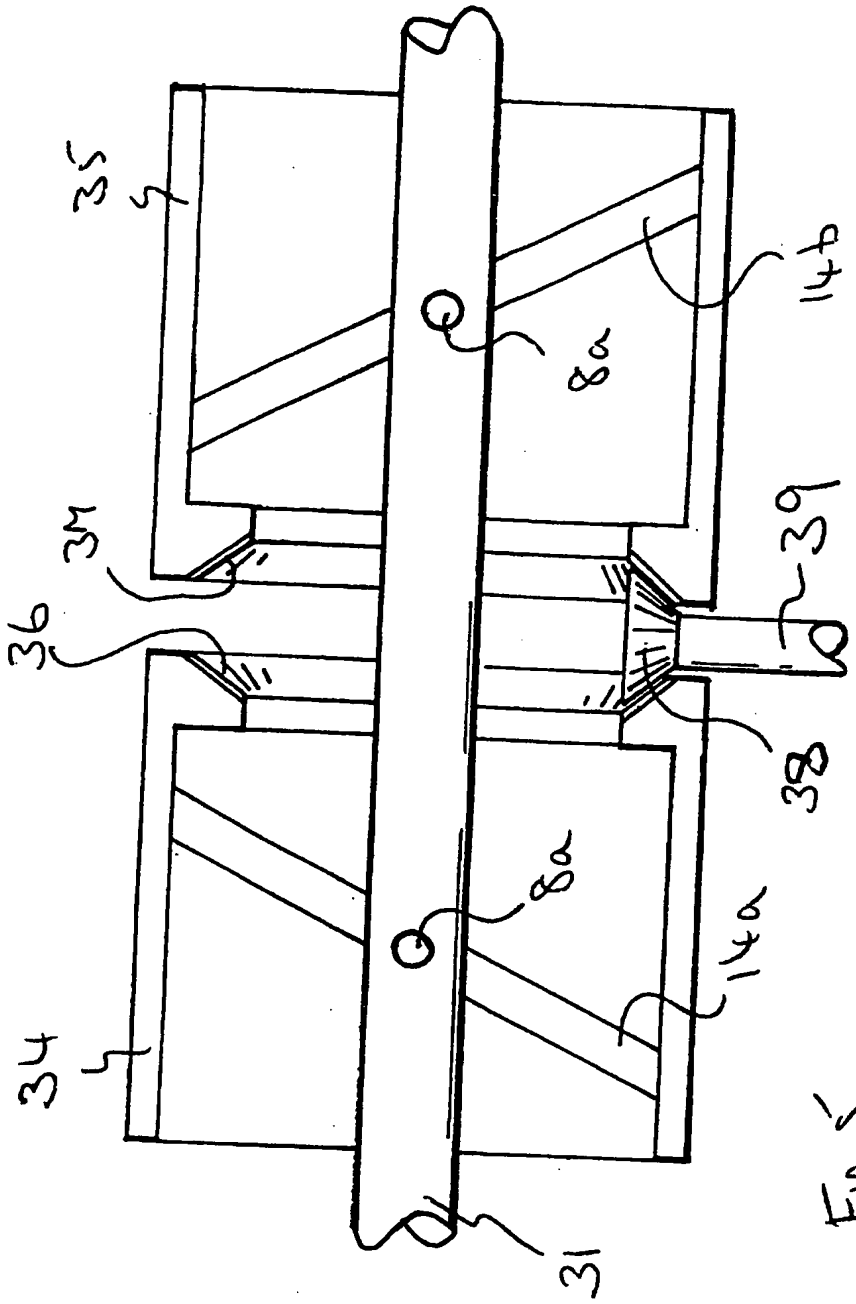

Fig 5

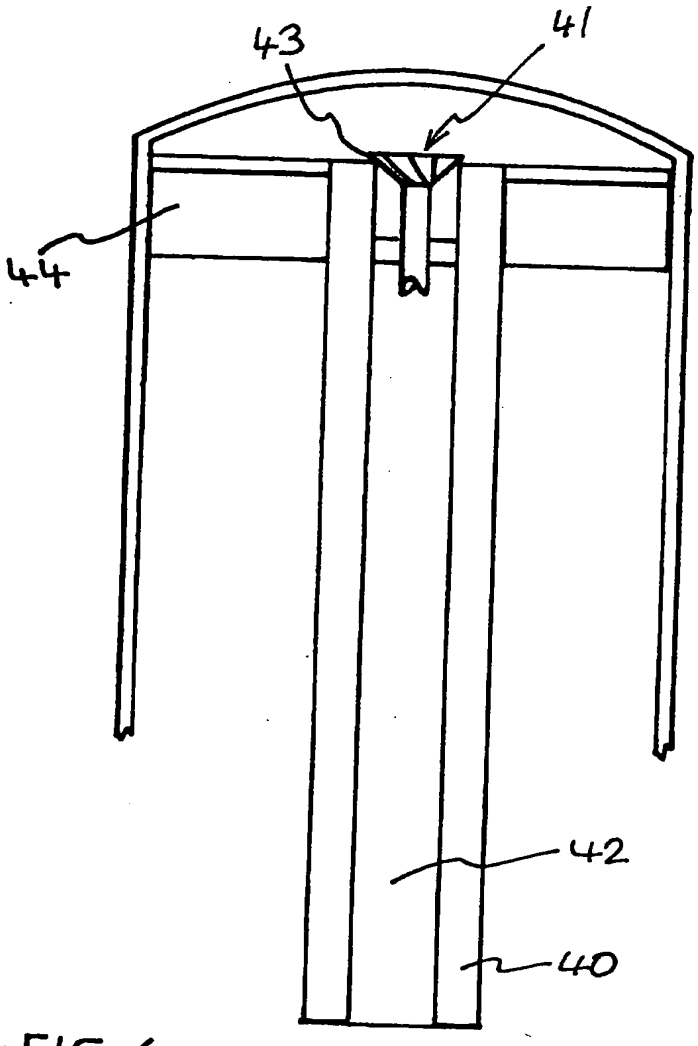

FIG 6

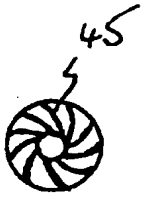

FIG 7

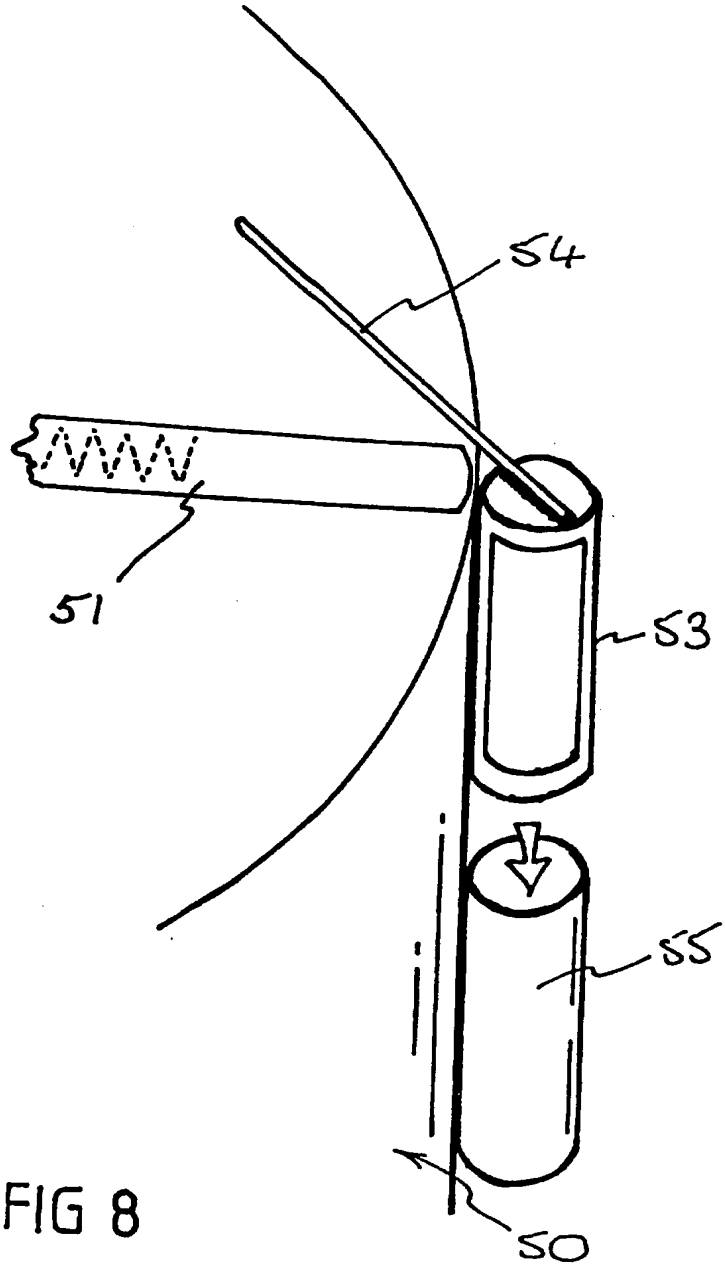

FIG 8

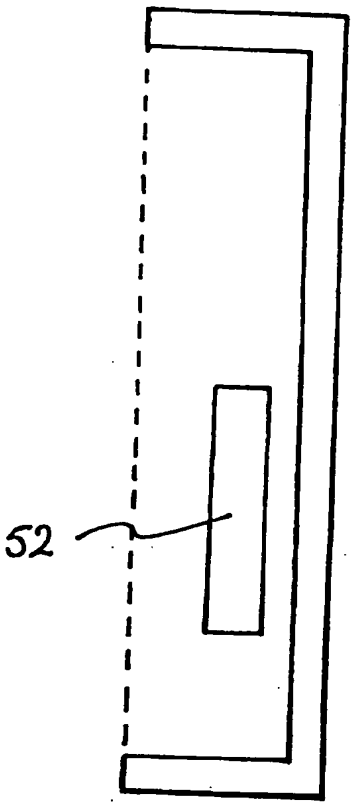

FIG 9

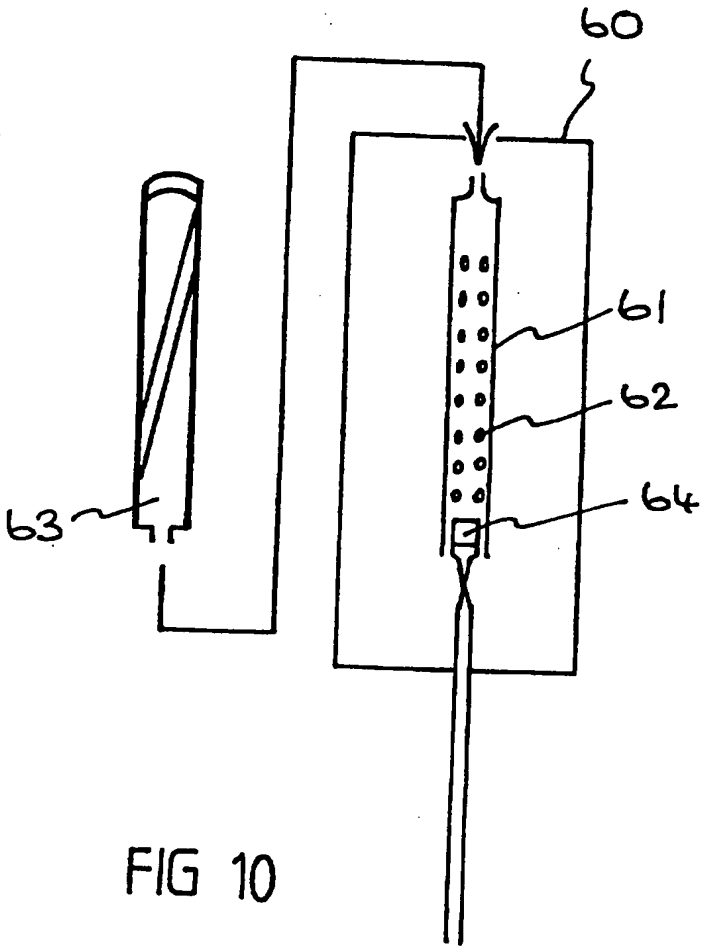

FIG 10

Gordon Lees Selman

INTERNAL COMBUSTION ENGINES

TECHNICAL FIELD OF THE INVENTION

This invention relates to internal combustion engines of the kind which translate reciprocal movement of a piston into rotational movement of an output shaft. The invention is applicable to both petrol and diesel engines.

SUMMARY OF THE INVENTION

The present invention firstly proposes an internal combustion engine comprising:

- a cylinder containing a piston working in a compression, ignition and combustion cycle, the piston being arranged to move a piston rod with a reciprocating motion;
- drive means including a pair of contra-rotating drive bodies, said drive means incorporating a guide body defining a continuous guide path which constrains the piston rod and the guide body to rotate relative to each other as the piston rod reciprocates; and
- an output shaft which is drivably engaged with both of said contra-rotating drive bodies to produce an output torque.

In one form of the invention the said drive bodies may comprise (i) the guide body, or another component which is rotatably driven by the guide body, and (ii) the piston rod, or a further component which is, in turn, driven from the piston rod. In another form of the invention the drive bodies may comprise a pair of contra-rotating guide bodies defining respective continuous guide paths, which are driven from the piston rod to rotate in opposite directions. This second form is preferred since the forces acting on the guide bodies may be balanced resulting in maximum efficiency.

The invention also proposes an internal combustion engine comprising a cylinder containing a piston working in a compression, ignition and combustion cycle, the piston being arranged to move a piston rod with a reciprocating motion, in which the piston rod contains an internal chamber for storage of compressed air, and valve means controlling communication between the said chamber and the combustion space within the cylinder.

The valve means is preferably mounted in the piston head, and may comprise a non-return valve. The valve member is preferably provided with a scroll formation for inducing a swirling motion to air entering the combustion space.

The invention further proposes an internal combustion engine comprising a cylinder containing a piston working in a compression, ignition and combustion cycle, the piston being arranged to move a piston rod with a reciprocating motion, the cylinder comprising inlet and outlet valves for controlling flow of gases to and from an internal combustion space within the cylinder, said valves including a valve member which is operated by a cam arranged to move outwardly with increasing rotational speed of the engine.

The cam is preferably carried by the cylinder, which is arranged to rotate.

The invention further proposes an internal combustion engine comprising a cylinder containing a piston working in a compression, ignition and combustion cycle, the piston being arranged to move a piston rod with a reciprocating motion, and in which fuel flows to the cylinder via a hollow body containing one or more apertures, and the opening of said aperture/s is controlled by a control member operated from an accelerator pedal.

In a preferred arrangement fuel is expelled from said body by a plunger mounted in the body and operated in accordance with the operating cycle of the engine.

BRIEF DESCRIPTION OF THE DRAWINGS

The following description and the accompanying drawings referred to therein are included by way of non-limiting example in order to illustrate how the invention may be put into practice. In the drawings:

Figure 1 is a longitudinal sectional view of a two stroke internal combustion engine of the invention,

Figure 2 is a two-dimensional drawing of the piston rod guide channel which is shown in section in Fig. 1

Figure 3 is a side elevation of a second form of engine in accordance with the invention,

Figure 4 is an end elevation of the arrangement shown in Fig. 3,

Figure 5 is a longitudinal section through a third form of engine in accordance with the invention,

Figure 6 is a detailed axial section through a preferred form of piston head which is adapted to act as a super-charger,

Figure 7 is a detail of the valve included in Fig. 6,

Figure 8 is a general perspective detail of a preferred form of valve arrangement for use in the engine,

Figure 9 is a longitudinal section through a cylinder housing as used with the valve arrangement of Fig. 8, and

Figure 10 shows part of a fuel injection system for use with the engine.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring firstly to Fig. 1, the engine comprises a pair of cylinders 1 and 2 connected by a common piston rod 3. The two cylinders work in co-operation 180° out of phase. Since the construction and operation of the two cylinders is substantially identical only one of the cylinders 2 will be described in detail.

Each cylinder is mounted in suitable bearings 4 to rotate about its axis. A piston 5 is mounted in the cylinder, coupled to one end of the rod 3 which in turn projects from one end of the cylinder, conveniently referred to herein as the "bottom" of the cylinder. The cylinder is provided with suitable inlet and outlet valves (not shown) allowing an air/fuel mixture to be fed into the top of the cylinder and venting exhaust gases as in the compression-ignition-combustion-exhaust cycle of a conventional internal combustion engine. A spark plug (again not shown) is inserted through the top end of the cylinder. The piston 5 and rod 3 are thus reciprocably driven as in a conventional engine.

The mid part of the piston rod 3 passes co-axially through a cylindrical guide body 7 which, although not shown in the drawings, is rotatably mounted in suitable bearings. A pin 8 is inserted radially through the rod 3, with the opposite ends of the pin located in a guide channel 9 formed in the wall of the body 7. Fig. 2 shows a planar representation of the channel 9, which in practice, extends continuously around the inside of the body 7 with the ends A joined together. It will thus be appreciated that the pin 8 and channel 9 constrain the piston rod to rotate relative to the guide body 7 and cylinder 2 as the rod reciprocates axially within the guide body 7. By this simple means reciprocal movement is directly converted into rotational movement.

A cylindrical coupling shaft 10 is located about the mid portion of the piston rod 3, provided with suitable bearings (not shown). The shaft 10 is keyed to the rod 3 by means of opposed axial slots 14 within which the pin 8 is free to travel axially. The shaft 10 is thus constrained to rotate with the piston rod 3, but without axial movement. The shaft 10 includes an annular end plate 15 carrying a bevel ring gear 16. A similar ring gear 17 is formed on

the adjacent end of the body 7, such that both gears 16 and 17 are engaged with a single bevel gear 19 of a transversely disposed output shaft 20.

It will be appreciated that the output torque is thus taken from both of the contra-rotating components formed by the guide body 7 and shaft 3, via the shaft 10 and bevel gearing.

An important point to note is that no crank shaft is required.

Whilst relative movement between the piston rod and the guide body is essential it is not necessary in all circumstances to have the cylinders mounted for rotation. It is, however, normally preferred for the cylinders to rotate since this allows a simple air cooling system to be employed. Thus, the cylinders will normally have external cooling fins. Rotation of the cylinders also allows a simple inlet and exhaust valve system to be employed, as will be described below.

In the arrangement shown in Fig.s 3 and 4 the cylinders may be fixed but they are preferably mounted for rotation as described above. The piston rod 3 is constrained by any suitable means (not shown) to prevent it from rotating. The piston rod 3 is again driven with a reciprocating motion and has opposed radially projecting pins 8. A pair of cylindrical guide bodies 21 and 22 are mounted to rotate on parallel axes on opposite sides of the piston rod 3. The guide bodies have substantially identical continuous external guide channels 23 and 24 within which the opposed pins 8 are located. Thus, again, the pins 8 and channels 23, 24 drive the pair of guide bodies to rotate relative to the piston rod 3 as the rod reciprocates axially so that reciprocal movement is directly converted into rotational movement.

As shown in Fig. 4, the guide bodies 21 and 22 are fixed with respective co-axial gears 25 and 26 which are, in turn, enmeshed with a pair of smaller coupling gears 27 and 28 which thus constrain the two guide bodies to rotate in opposite directions, as indicated by the arrows. The output shaft may be driven from one of the coupling gears 27 or 28, or from one of the guide bodies 21, 22. The take-off point is not important since the gearing arrangement ensures that the power is transferred from both guide bodies to the output shaft.

In a further embodiment of the apparatus which is shown in Fig. 5, a common shaft 31 has oppositely acting pistons and cylinders at opposite ends (not shown). The cylinders are again rotatably mounted but are fixed with respective guide bodies 34 and 35. A pin and guide channel arrangement 8a, 14a and 8b, 14b constrains the guide bodies 34 and 35 to rotate in opposite directions, and the output torque is taken from both guide bodies via ring gears 36 and 37 and a bevel gear 38 fixed with a transverse output shaft 39.

The forms of engine described above can be provided with a form of super charging. As shown in Fig. 6, pre-compression is achieved by use of a hollow piston rod 40 which connects the two piston heads. Each end of the rod is provided with a non-return valve 41 to control communication between the respective cylinder and the chamber 42 formed inside the rod. A reservoir of compressed air is stored in the chamber when the cylinder is under compression, but when the pressure in a cylinder falls the valve opens to admit pre-compressed air into the cylinder. The valve seals against a seat 43 formed in the piston head 44, but as shown in Fig. 7, the underside of the valve head is provided with scrolls 45 which induce a swirling action

as the pre-compressed air enters the cylinder, there by enhancing the mixing of air and fuel.

A valve arrangement which is preferred for use with the above-described forms of engine is shown in Fig. 8. Each rotating cylinder, indicated at 50, is provided with a spring loaded sliding cam 51 which is arranged to move radially outwards under rotational forces as engine speed increases. At the appropriate points in the engine cycle, ports in the cylinder wall (not shown) are arranged to align with ports 52 formed in the cylinder housing (Fig. 9). The opening of these ports 52 is advanced and retarded by windowed cylindrical valve members 53 provided with operating arms 54 which are housed in casings 55 mounted in registration with the ports 52. The arms 54 co-operate with the cams 51 in such a way that the opening of the ports 52 varies with the speed of the engine.

The forms of engine described herein may also utilise a fuel injection system which is shown in Fig. 10. A fuel reservoir 60 contains a cylindrical body 61 having apertures 62 in its wall. An outer cylindrical cover 63, shown separately for clarity of illustration, is rotatably mounted about the body, linked to the accelerator pedal in such a way as to increase the number of apertures which are open in accordance with the amount by which the accelerator pedal is depressed. The body 61 receives fuel from a suitably positioned inlet (not shown) and contains an injection plunger 64 which is operated from a cam profile (not shown) carried by and fixed with the respective rotating cylinder. When required, the plunger 64 moving within the body 61, injects fuel into the cylinder via an injection outlet (not shown). By suitably configuring the profile of the cam, a spurt of fuel can be injected at the required point in the engines operating cycle.

A number of important advantages stem from the arrangements described above, including the following:

* There is no side thrust on the walls of the cylinders 1 and 2, so that friction and wear are reduced.

* The efficiency of the engine is improved.

* Power output is increased.

* Fuel consumption is reduced.

* The engine can be constructed with a reduced weight and lower inertia losses. The power/weight ratio is thus improved.

* The engine can be cheaper to build and service.

The arrangements described can be used in two stroke engines. The arrangement can also be adapted to provide a four stroke engine using two double-acting cylinders, although suitable cooling arrangements will be required. Theoretically, a three stroke engine would also be possible.

To assist the engine to function effectively under slow running conditions tension springs can be added between the bottom of each piston and the end of the respective cylinder.

Whilst the above description lays emphasis on those areas which, in combination, are believed to be new, protection is claimed for any inventive

combination of the features disclosed herein.

* * * * * * * *

CLAIMS

1. An internal combustion engine comprising:
- a cylinder containing a piston working in a compression, ignition and combustion cycle, the piston being arranged to move a piston rod with a reciprocating motion;
- drive means including a pair of contra-rotating drive bodies, said drive means incorporating a guide body defining a continuous guide path which constrains the piston rod and the guide body to rotate relative to each other as the piston rod reciprocates; and
- an output shaft which is drivably engaged with both of said contra-rotating drive bodies to produce an output torque.

2. An engine according to Claim 1, in which a radial projection is fixed with the piston rod or the guide body and which moves along a guideway defined by the guide body or the piston rod respectively.

3. An engine according to Claim 1 or 2, in which the guide body is mounted co-axially with the piston rod.

4. An engine according to Claim 3, in which the guide body is mounted about the piston rod.

5. An engine according to Claim 4, in which the guide path is defined internally of the guide body.

6. An engine according to any preceding claim, in which the

piston rod rotates.

7. An engine according to Claim 6, in which the output shaft is driven from the piston rod.

8. An engine according to Claim 7, in which the output shaft is driven from the piston rod via a rotatably mounted tubular coupling shaft mounted concentrically about the piston rod such that the piston rod is reciprocable within said coupling shaft, the coupling shaft being constrained to rotate with the piston rod.

9. An engine according to Claim 1 or 2, in which the guide body is mounted alongside the piston rod.

10. An engine according to Claim 9, in which the guide path is defined externally of the guide body.

11. An engine according to Claim 9 or 10, in which the piston rod drives two such guide bodies and the output shaft is driven from both guide bodies.

12. An engine according to any preceding claim, in which the guide body rotates.

13. An engine according to any preceding claim, in which the output shaft is driven from the guide body.

14. An engine according to any preceding claim, in which the

cylinder communicates with a storage chamber into which gases are compressed from below the piston, valve means being provided such that the compressed gasses are returned to the upper part of the cylinder.

15. An engine according to Claim 14, in which the storage chamber is formed within the piston.

16. An engine according to Claim 14 or 15, in which the valve means is mounted in the piston head

17. An engine according to Claim 16, in which the valve means comprises a non-return valve.

18. An engine according to any of Claims 14 to 17, in which the valve means comprises a valve member provided with a scroll formation for inducing a swirling motion to air entering the combustion space.

19. An engine according to any preceding claim, in which the cylinder comprises inlet and outlet valves for controlling flow of gases to and from an internal combustion space within the cylinder, said valves including a valve member which is operated by a cam arranged to move outwardly with increasing rotational speed of the engine.

20. An engine according to Claim 19, in which the cam is carried by the cylinder, which is arranged to rotate.

21. An engine according to any preceding claim, in which fuel flows to the cylinder via a hollow body containing one or more apertures, and

the opening of said aperture/s is controlled by a control member operated from an accelerator pedal.

22. An engine according to Claim 21, in which fuel is expelled from said hollow body by a plunger mounted in the body and operated in accordance with the operating cycle of the engine.

23. An internal combustion engine substantially as described with reference to the drawings.

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The Patent Office

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Application No: GB 9912392.9
Claims searched: 1 to 23

Examiner: John Twin
Date of search: 3 August 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F1B (B5R1D)

Int Cl (Ed.6): F01B 3/04, 3/06, 9/06; F02B 75/26

Other: Online: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 648917 A1	(Furukawa) - see eg figs.2, 4-7	1 at least
A	EP 566072 A1	(T I E)	
X	US 5351657	(Buck) - see eg fig.14	1 at least
X	US 4554787	(Wilhelm) - see eg fig.6	1 at least
A	US 4462345	(Pulsar)	
X	WO 87/03644 A1	(Söderström) - see eg fig.7	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.